FIG. 1A

RGB data &
Control signals
for LCD panel

Pins for I2C device
ID setting

MAIN CPU
11

McBSP
(6 Mpbs)

UAR

IIC

Data Interface 1

Control Interface

Data Interface 2

VIDEO
CODEC
12

RGB,Clock & Sync
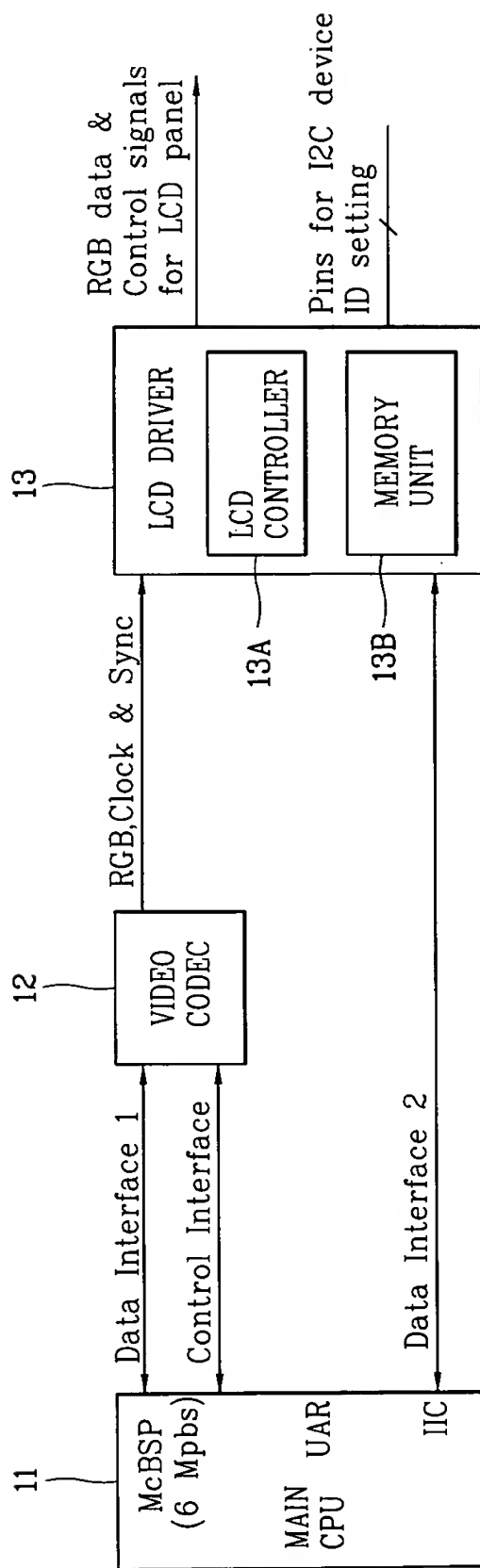
LCD DRIVER
13

LCD
CONTROLLER
13A

MEMORY
UNIT
13B

FIG. 1B

3 Mode Operation

Active Mode(Data Interface 1):
−JPEG,GIF
−MPEG4
−MP3(128kbps).AAC
−Animation(Game)
−Text Service

Standby Mode(Data Interface 2):
−Animation, Still Image & Text, Text only

Power Down Mode
−LCD Driver IC power off, but SRAM is alive

Display Scheme

Active Mode
−Normal Operation
−Main CPU, Video CODEC and LCD driver IC are all alive
−LCD display frame rate of ∼30 frames/sec

Standby Mode
−Power Saving Mode(Video CODEC is powered off)
−Animation or Still Image & Text or Text can be displayed
−LCD display frame rate of∼5 frames/sec

Power Down Mode
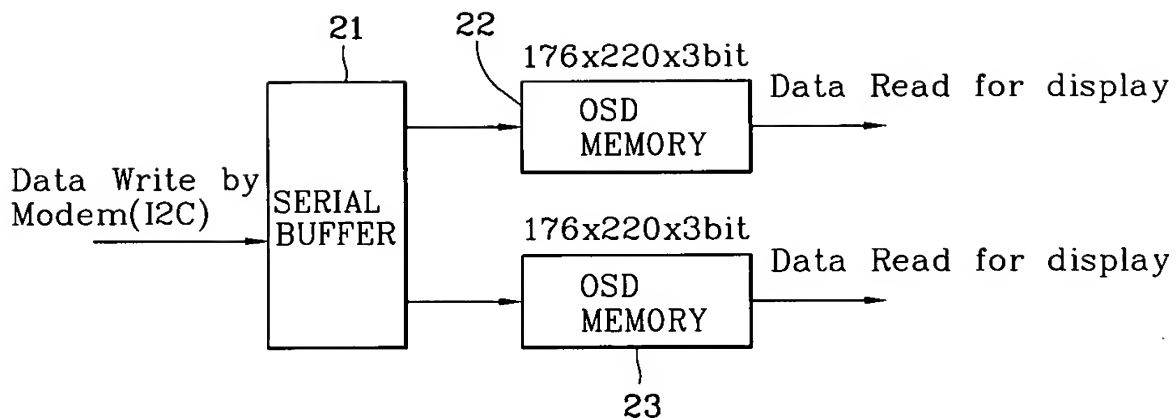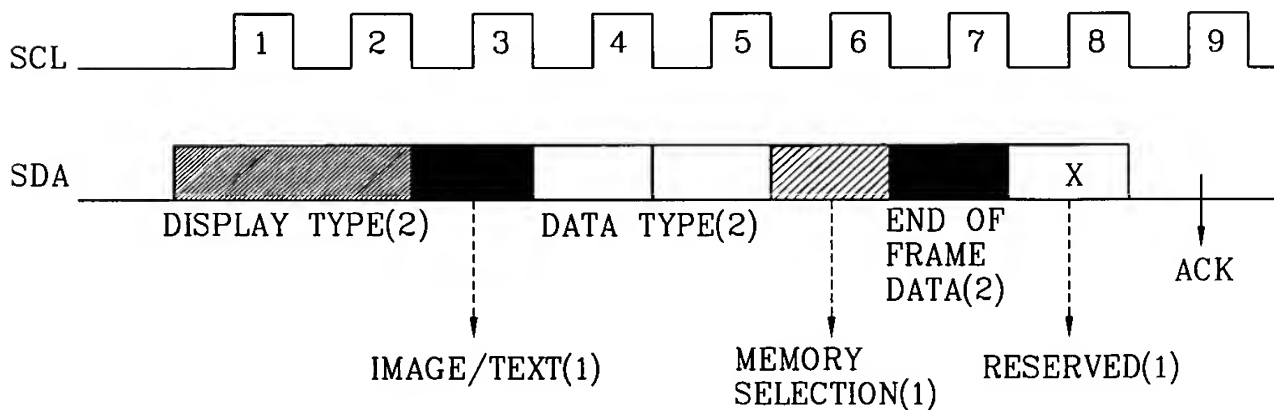−Nothing is displayed, Ready for displaying

FIG. 2

21   22   176x220x3bit

Data Write by
Modem(I2C) → SERIAL
BUFFER → OSD
MEMORY → Data Read for display

176x220x3bit

OSD
MEMORY → Data Read for display

23

FIG. 3

SCL 1 2 3 4 5 6 7 8 9

SDA DISPLAY TYPE(2) | DATA TYPE(2) | END OF FRAME DATA(2) | X

ACK

IMAGE/TEXT(1)   MEMORY SELECTION(1)   RESERVED(1)

DISPLAY TYPE(2bits)	IMAGE/TEXT(1bit)	DATA TYPE(2bit)
00: ANIMATION	0: TEXT DATA	00: BURST DATA
01: STILL IMAGE & TEXT	1: IMAGE DATA	01: AREA DATA
10: TEXT ONLY		10: LINE DATA
11: REGISTER CONTROL		11: PIXEL DATA

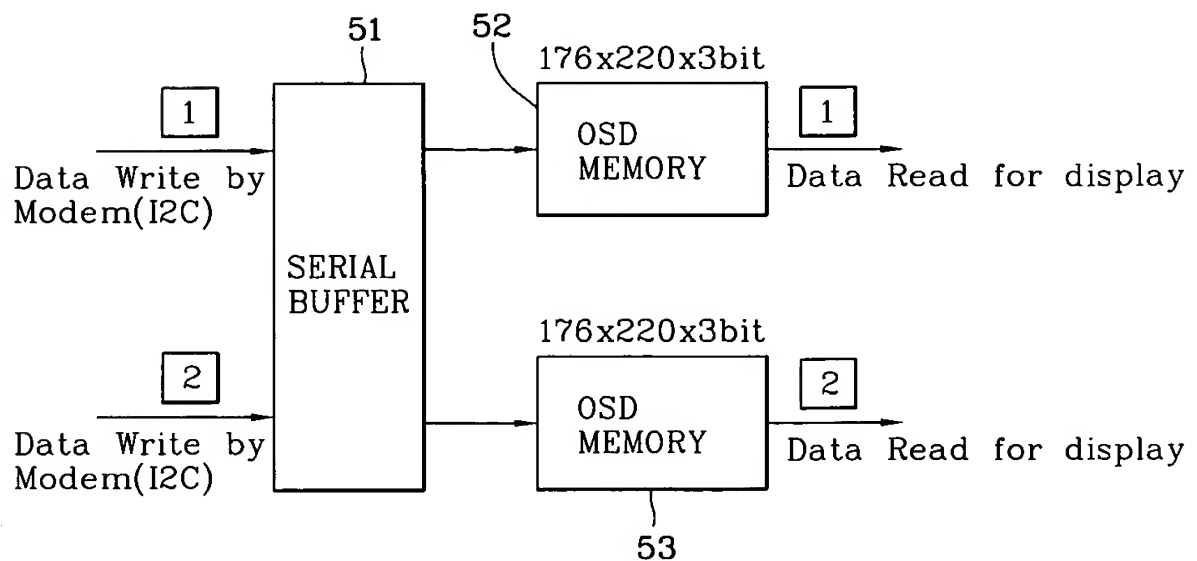| OSD MEMORY SELECTION(1bit)	END OF FRAME DATA(1bit)
0: OSD MEMORY 1(FIRST)	0: NOT EOFD
1: OSD MEMORY 2(SECOND)	1: EOFD

FIG. 4

IMAGE DATA REPRESENTATION(3bits)
000: BLACK
001: BLUE
010: GREEN
011: CYAN
100: RED
101: MAGENTA
110: YELLOW
111: WHITE

TEXT DATA REPRESENTATION(1bit)
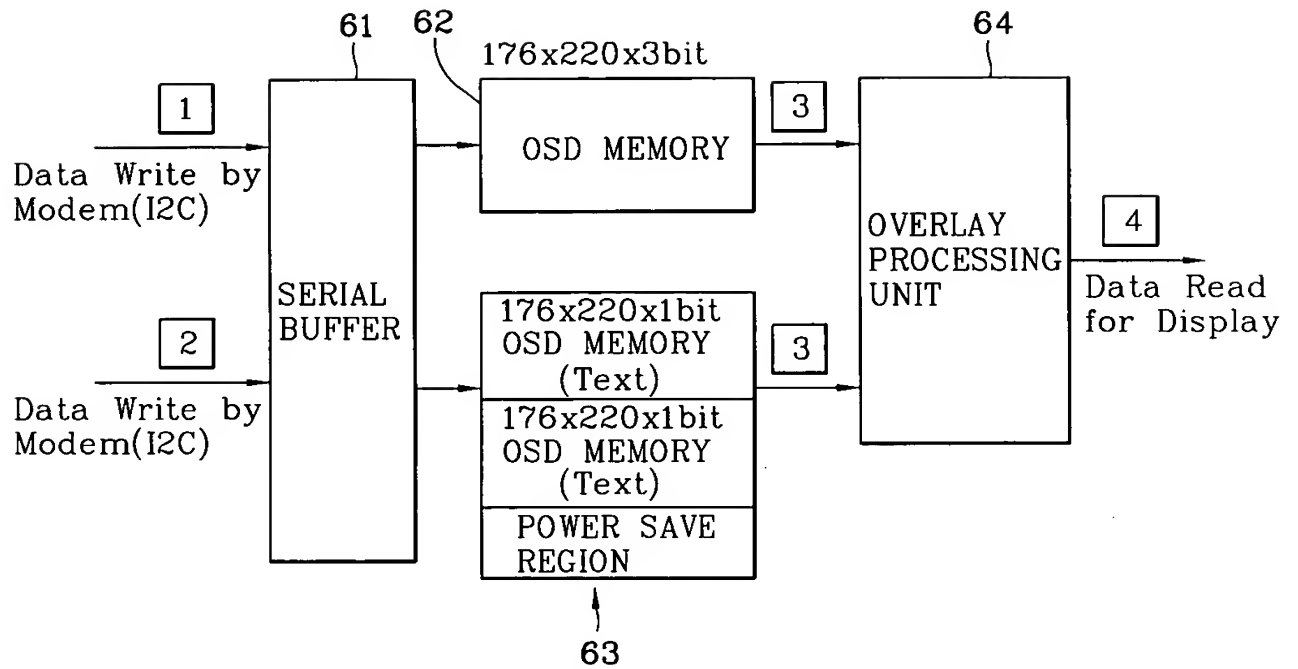0: BACKGROUND DATA
1: TEXT DATA

FIG. 5

51 52 176x220x3bit

1
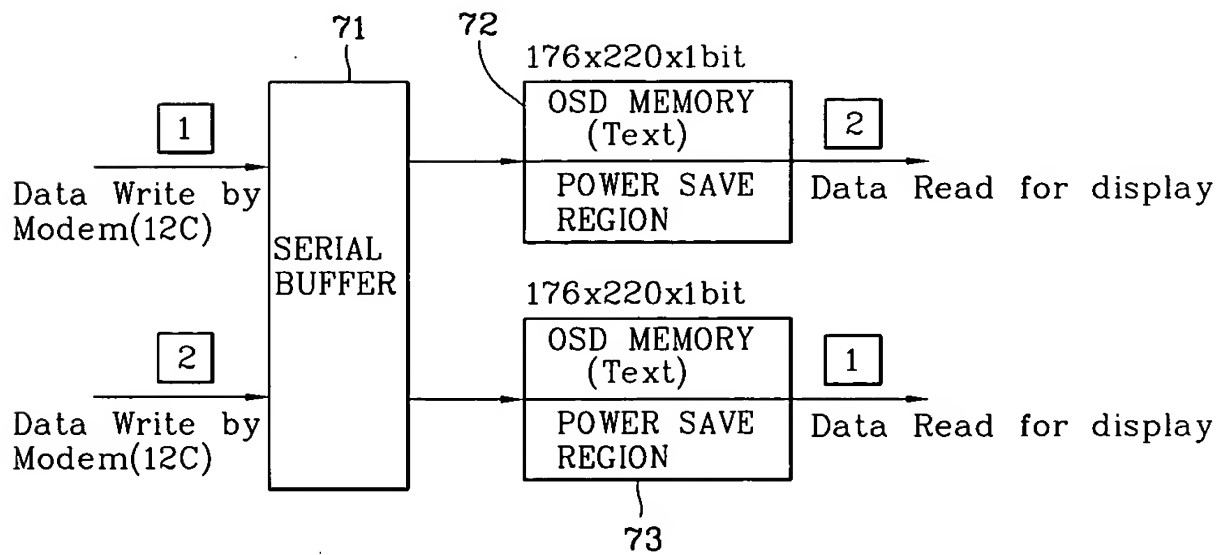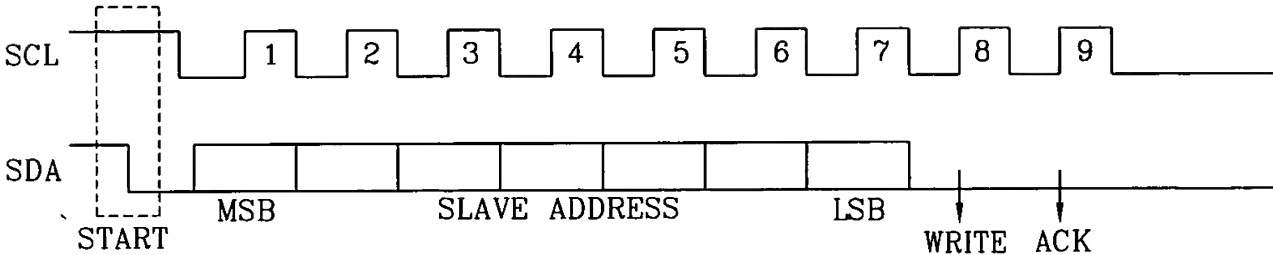Data Write by
Modem(I2C)

SERIAL
BUFFER

OSD
MEMORY

1
Data Read for display

2
Data Write by
Modem(I2C)

176x220x3bit

OSD
MEMORY

2
Data Read for display

53

FIG. 6

176x220x3bit

```
[1] Data Write by Modem(I2C) → SERIAL BUFFER (61)
[2] Data Write by Modem(I2C) → SERIAL BUFFER (61)

SERIAL BUFFER → OSD MEMORY (62)  176x220x3bit
SERIAL BUFFER → 176x220x1bit OSD MEMORY (Text) / 176x220x1bit OSD MEMORY (Text) / POWER SAVE REGION (63)

OSD MEMORY [3] → OVERLAY PROCESSING UNIT (64)
OSD MEMORY (Text) [3] → OVERLAY PROCESSING UNIT (64)
OVERLAY PROCESSING UNIT → [4] Data Read for Display
```

FIG. 7


```
[1] Data Write by Modem(I2C) → SERIAL BUFFER (71)
[2] Data Write by Modem(I2C) → SERIAL BUFFER (71)

SERIAL BUFFER → 176x220x1bit OSD MEMORY (Text) / POWER SAVE REGION (72) → [2] Data Read for display
SERIAL BUFFER → 176x220x1bit OSD MEMORY (Text) / POWER SAVE REGION (73) → [1] Data Read for display
```

FIG. 8A

CASE 1. BURST DATA WRITE(IMAGE)
SLAVE ADDRESS TRANSFER

SCL

SDA

START MSB SLAVE ADDRESS LSB WRITE ACK

MODE SETTING

SCL

SDA 1 0 0 1 X

DISPLAY TYPE BURST DATA OSD EOFD ACK
IMAGE MEMORY
SELECTION

PIXEL DATA TRANSFER

SCL

SDA X X

PIXEL DATA 0 PIXEL DATA 1 ACK

SCL

SDA X X

PIXEL DATA 38718 PIXEL DATA 38719 ACK STOP
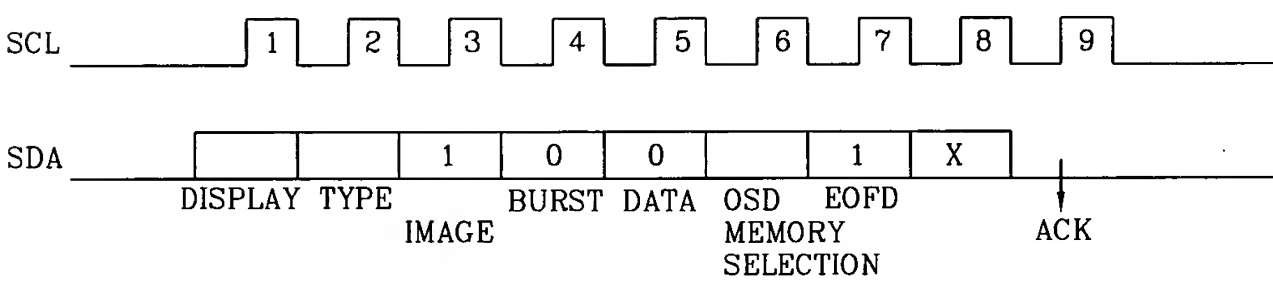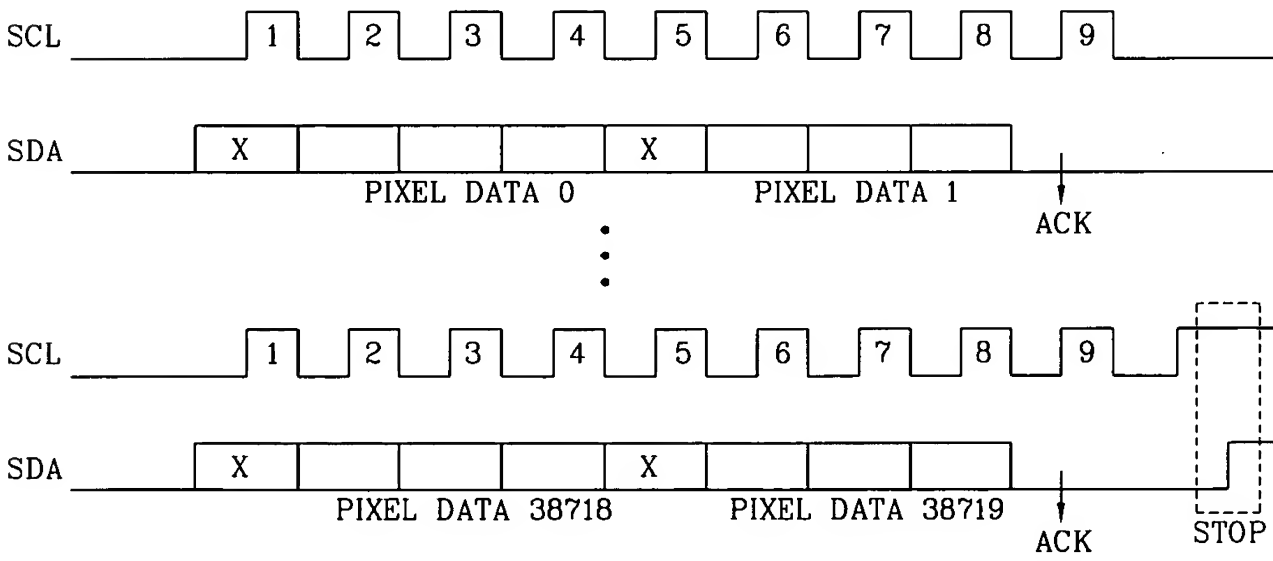
FIG. 8B

CASE 2. AREA DATA WRITE(IMAGE)

SLAVE ADDRESS TRANSFER
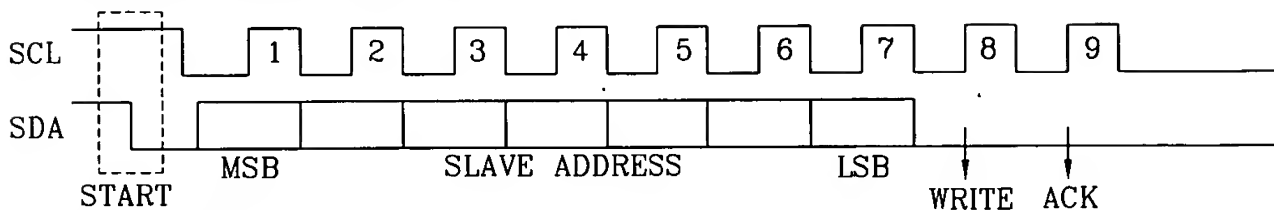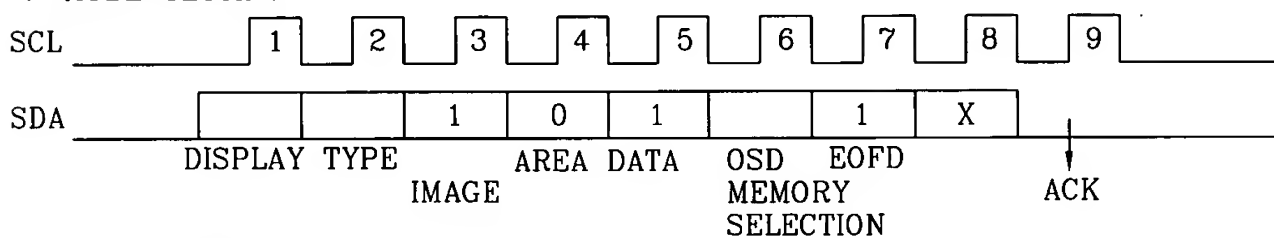
SCL ⎍ 1 2 3 4 5 6 7 8 9

SDA

MSB   SLAVE ADDRESS   LSB

START   WRITE   ACK

MODE SETTING

SCL 1 2 3 4 5 6 7 8 9

SDA   1   0   1   1   X

DISPLAY TYPE   AREA DATA   OSD EOFD
         IMAGE   MEMORY   ACK
                             SELECTION

AREA START ADDRESS TRANSFER

SCL 1 2 3 4 5 6 7 8 9

SDA A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8

SDA A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0   ACK

                                              ACK

AREA END ADDRESS TRANSFER

SCL 1 2 3 4 5 6 7 8 9

SDA A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8

SDA A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0   ACK

                                              ACK

PIXEL DATA TRANSFER

SCL 1 2 3 4 5 6 7 8 9

SDA X   X

PIXEL DATA M   PIXEL DATA M+1   ACK

SCL 1 2 3 4 5 6 7 8 9

SDA X   X

PIXEL DATA N−1   PIXEL DATA N   ACK   STOP
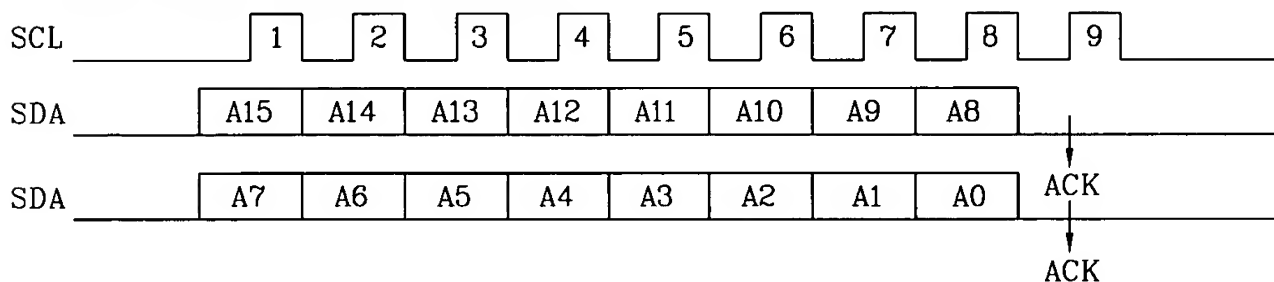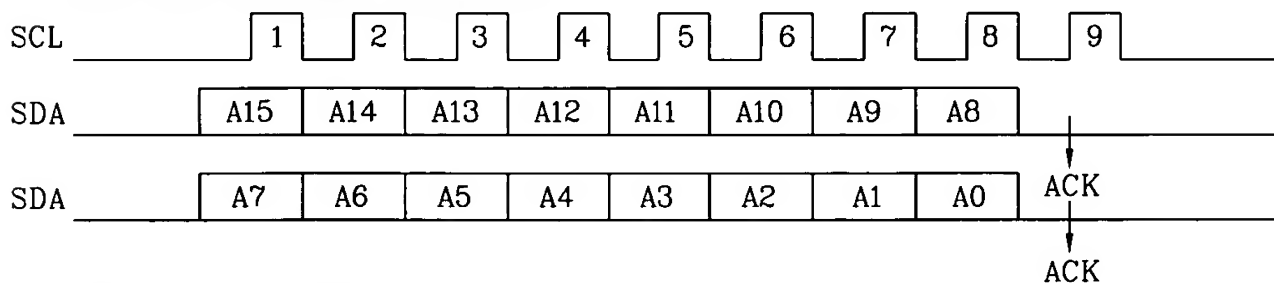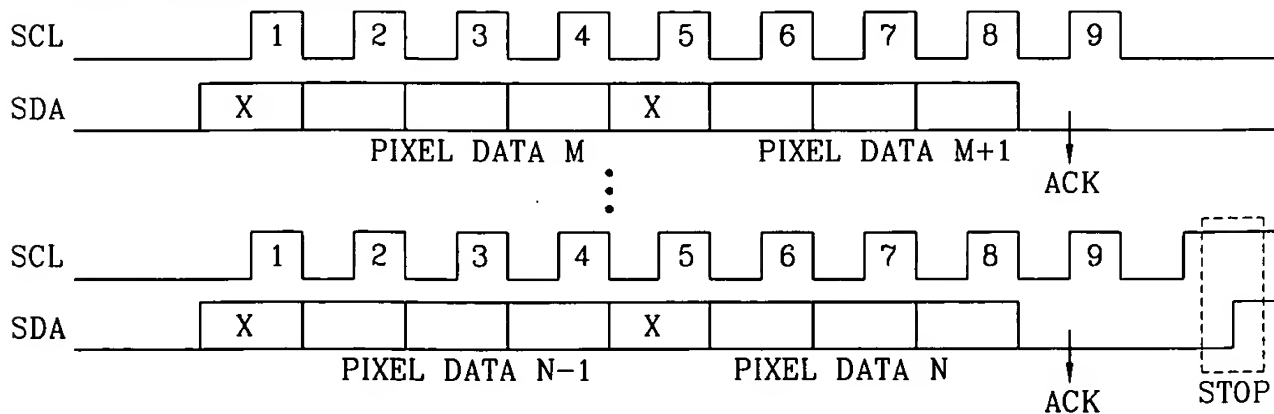
FIG. 8C

CASE 3. LINE DATA WRITE(IMAGE)

SLAVE ADDRESS TRANSFER
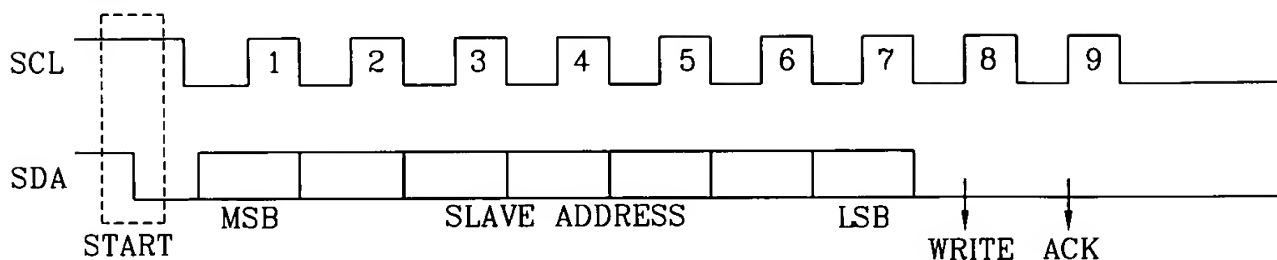
SCL ___ ⌐1⌐ ⌐2⌐ ⌐3⌐ ⌐4⌐ ⌐5⌐ ⌐6⌐ ⌐7⌐ ⌐8⌐ ⌐9⌐

SDA

START   MSB   SLAVE ADDRESS   LSB   WRITE   ACK

MODE SETTING

SCL ⌐1⌐ ⌐2⌐ ⌐3⌐ ⌐4⌐ ⌐5⌐ ⌐6⌐ ⌐7⌐ ⌐8⌐ ⌐9⌐

SDA | | | 1 | 1 | 0 | | | X |

DISPLAY TYPE   LINE DATA   OSD EOFD   ACK
        IMAGE   MEMORY
                            SELECTION

LINE ADDRESS TRANSFER

SCL ⌐1⌐ ⌐2⌐ ⌐3⌐ ⌐4⌐ ⌐5⌐ ⌐6⌐ ⌐7⌐ ⌐8⌐ ⌐9⌐

SDA | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |

ACK

PIXEL DATA TRANSFER

SCL ⌐1⌐ ⌐2⌐ ⌐3⌐ ⌐4⌐ ⌐5⌐ ⌐6⌐ ⌐7⌐ ⌐8⌐ ⌐9⌐

SDA | X | | | | X | | | |

PIXEL DATA 0   PIXEL DATA 1   ACK

•
•
•

SCL ⌐1⌐ ⌐2⌐ ⌐3⌐ ⌐4⌐ ⌐5⌐ ⌐6⌐ ⌐7⌐ ⌐8⌐ ⌐9⌐

SDA | X | | | | X | | | |

PIXEL DATA 174   PIXEL DATA 175   ACK   STOP
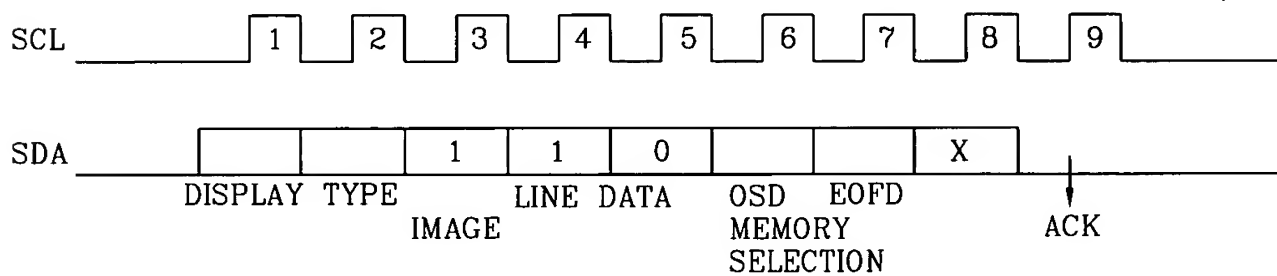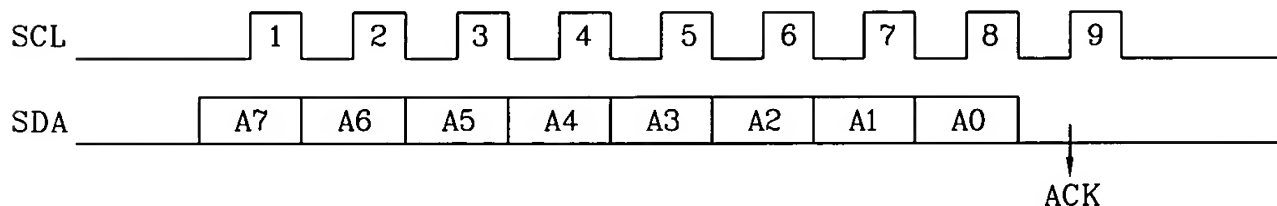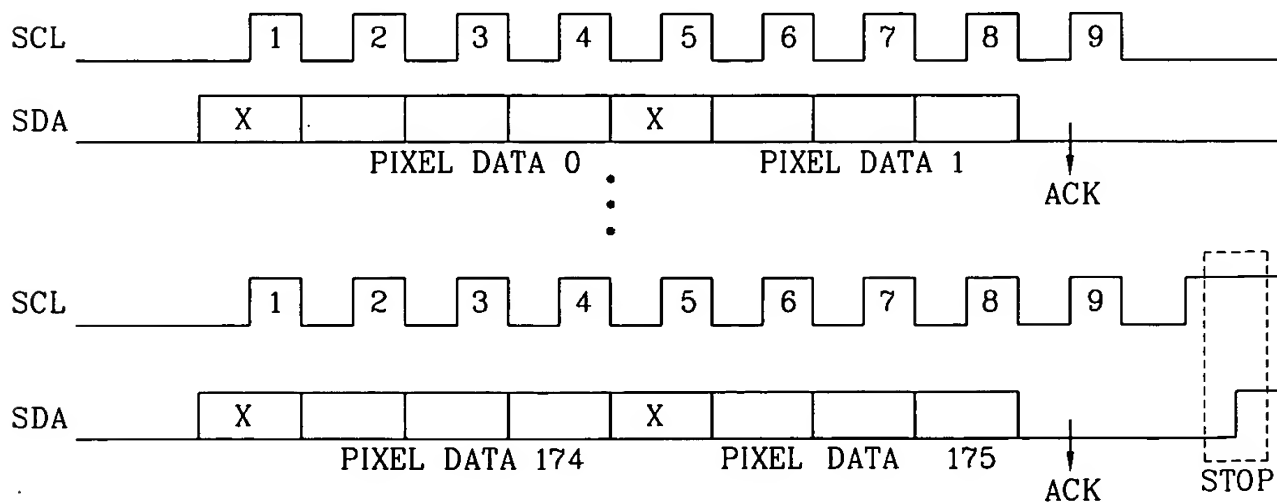
FIG. 8D

CASE 4. PIXEL DATA WRITE(IMAGE)
SLAVE ADDRESS TRANSFER
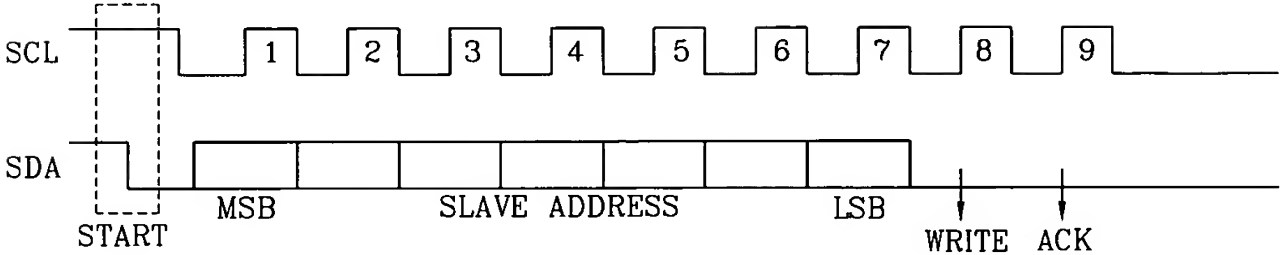
SCL: 1 2 3 4 5 6 7 8 9

SDA

START | MSB | SLAVE ADDRESS | LSB | WRITE | ACK

MODE SETTING

SCL: 1 2 3 4 5 6 7 8 9

SDA: 1 1 1 X

DISPLAY TYPE | IMAGE | PIXEL DATA | OSD | EOFD | ACK
MEMORY SELECTION

PIXEL ADDRESS TRANSFER

SCL: 1 2 3 4 5 6 7 8 9

SDA: A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8 | ACK

SDA: A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | ACK | ACK

PIXEL DATA TRANSFER

SCL: 1 2 3 4 5 6 7 8 9

SDA: X | X

PIXEL DATA N | PIXEL DATA N+1 | ACK | STOP
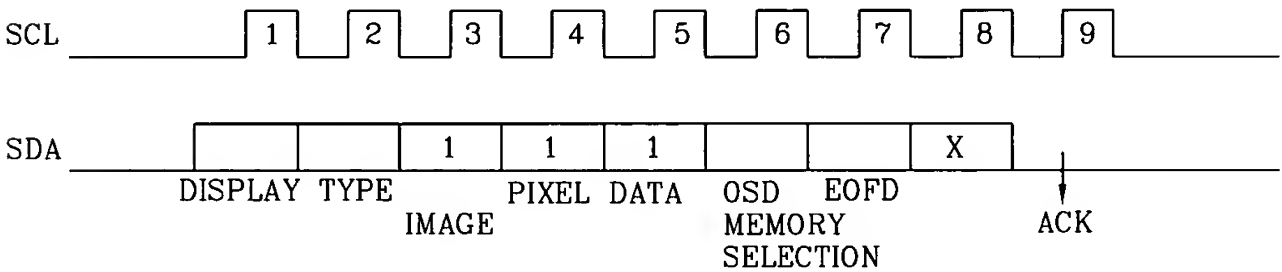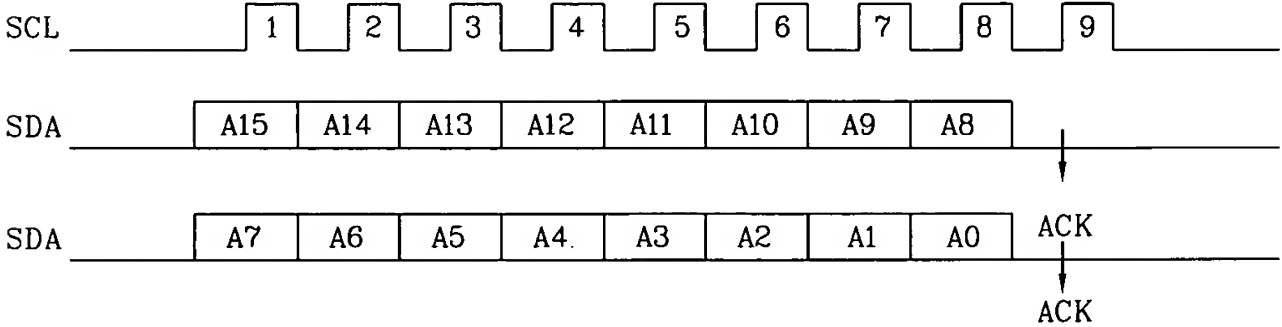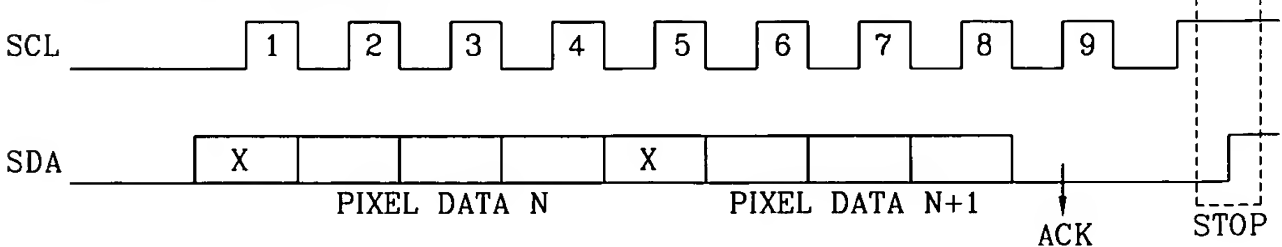
FIG. 8E

CASE 5. BURST DATA WRITE(TEXT)
SLAVE ADDRESS TRANSFER

SCL | 1 2 3 4 5 6 7 8 9

SDA

START MSB SLAVE ADDRESS LSB WRITE ACK

MODE SETTING

SCL | 1 2 3 4 5 6 7 8 9

SDA | 0 0 0 1 X

DISPLAY TYPE TEXT BURST DATA OSD MEMORY SELECTION EOFD ACK

TEXT DATA TRANSFER

SCL | 1 2 3 4 5 6 7 8 9

SDA | D0 D1 D2 D3 D4 D5 D6 D7

TEXT DATA 0 ACK

SCL | 1 2 3 4 5 6 7 8 9

SDA | D38712 D38713 D38714 D38715 D38716 D38717 D38718 D38719

TEXT DATA 38719 STOP
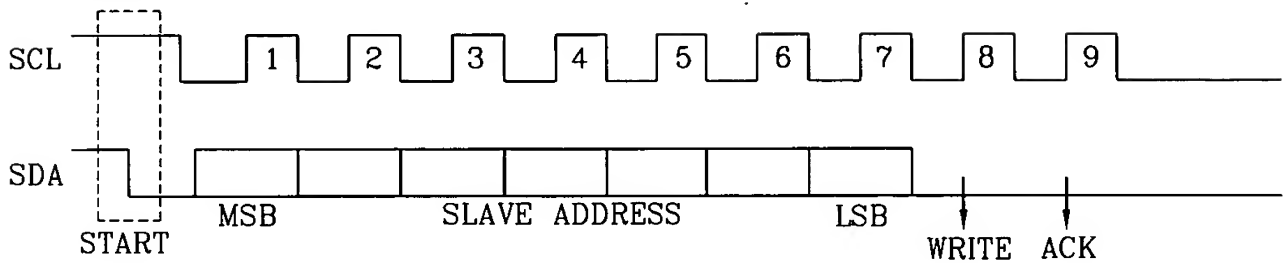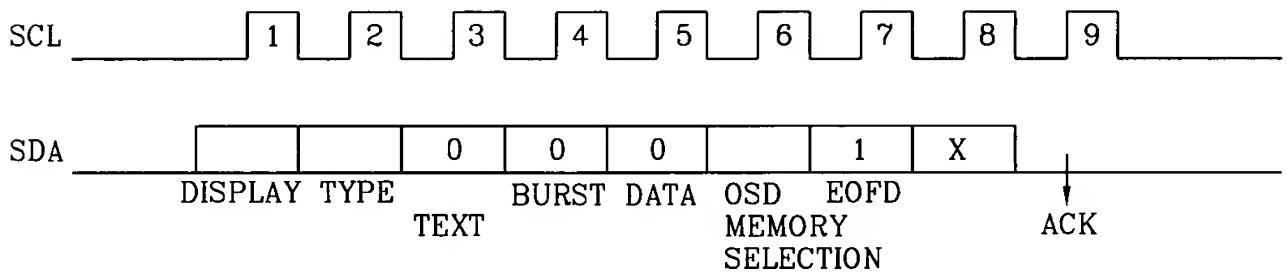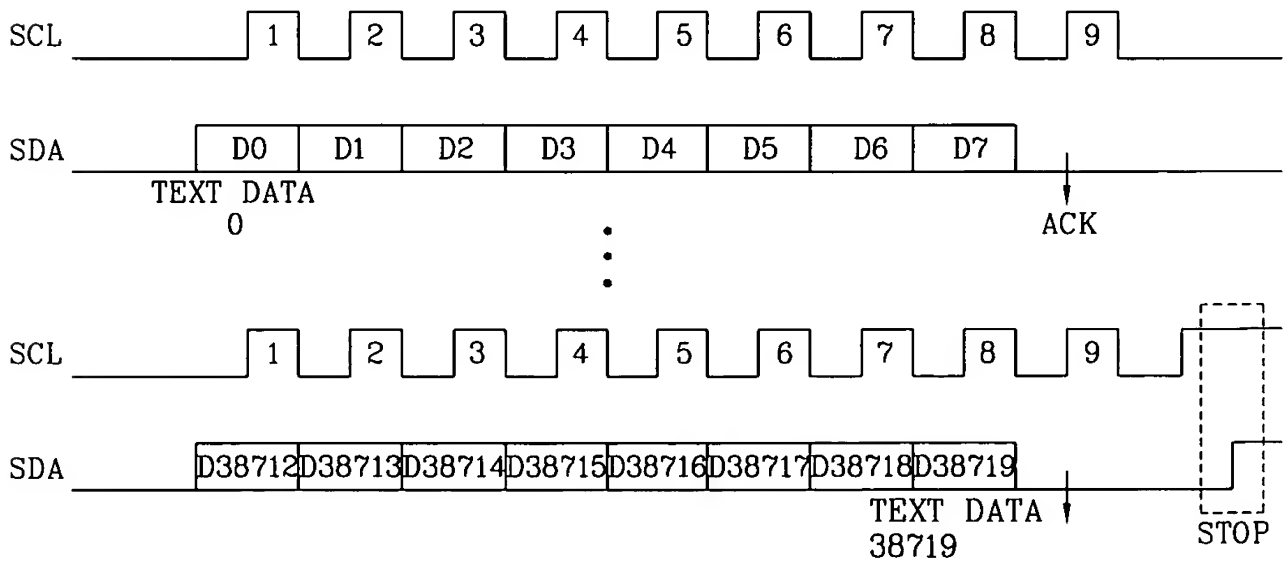
FIG. 8F

CASE 6. AREA DATA WRITE(TEXT)

SLAVE ADDRESS TRANSFER
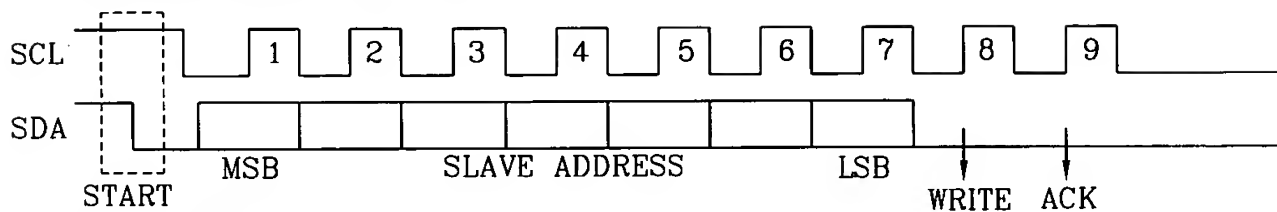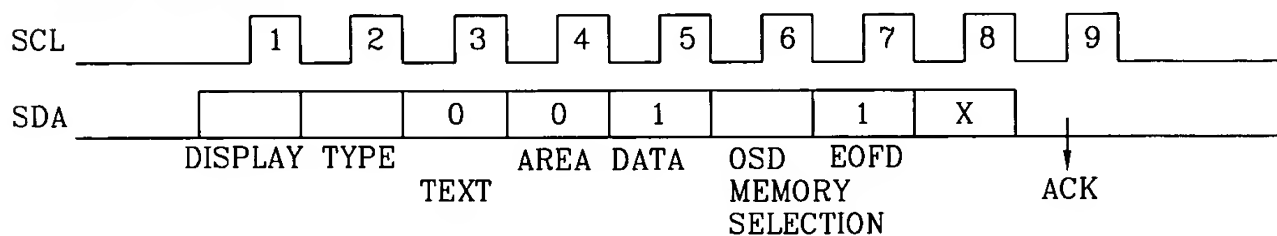
SCL: 1 2 3 4 5 6 7 8 9

SDA: START | MSB — SLAVE ADDRESS — LSB | WRITE ACK

MODE SETTING

SCL: 1 2 3 4 5 6 7 8 9

SDA: DISPLAY TYPE | 0 0 1 (TEXT / AREA DATA) | 1 (OSD MEMORY SELECTION) X (EOFD) | ACK

AREA START ADDRESS TRANSFER

SCL: 1 2 3 4 5 6 7 8 9

SDA: A15 A14 A13 A12 A11 A10 A9 A8 | ACK

SDA: A7 A6 A5 A4 A3 A2 A1 A0 | ACK

AREA END ADDRESS TRANSFER

SCL: 1 2 3 4 5 6 7 8 9

SDA: A15 A14 A13 A12 A11 A10 A9 A8 | ACK

SDA: A7 A6 A5 A4 A3 A2 A1 A0 | ACK

TEXT DATA TRANSFER

SCL: 1 2 3 4 5 6 7 8 9

SDA: D_M D_M+1 D_M+2 D_M+3 D_M+4 D_M+5 D_M+6 D_M+7 | ACK

SCL: 1 2 3 4 5 6 7 8 9

SDA: D_N-7 D_N-6 D_N-5 D_N-4 D_N-3 D_N-2 D_N-1 D_N | ACK STOP
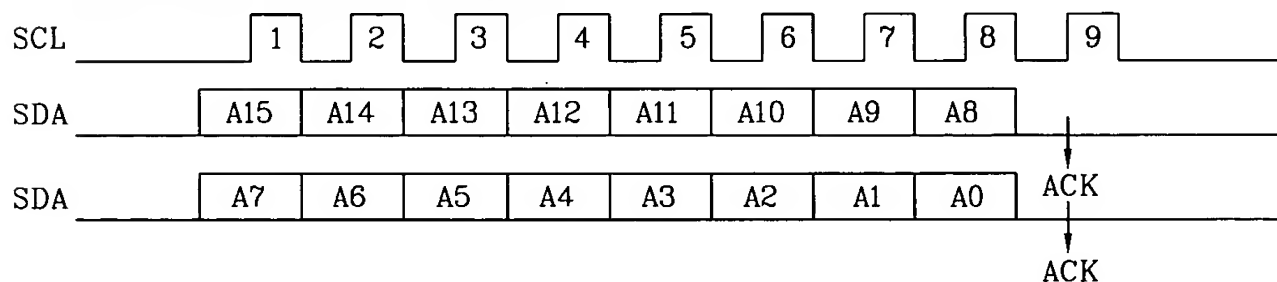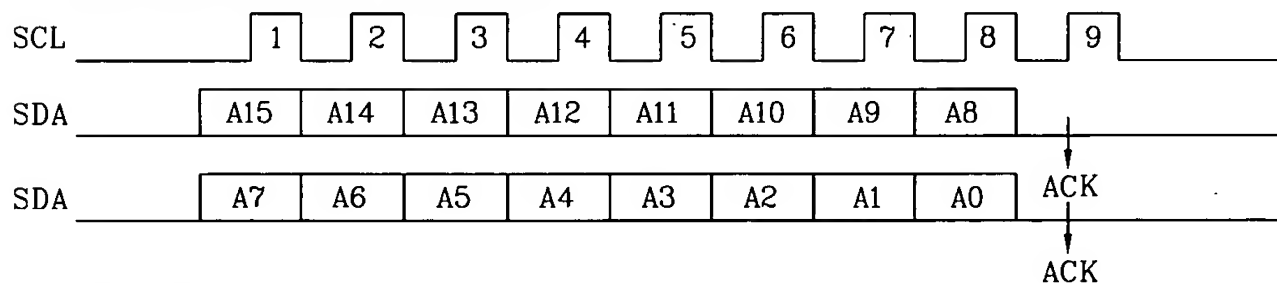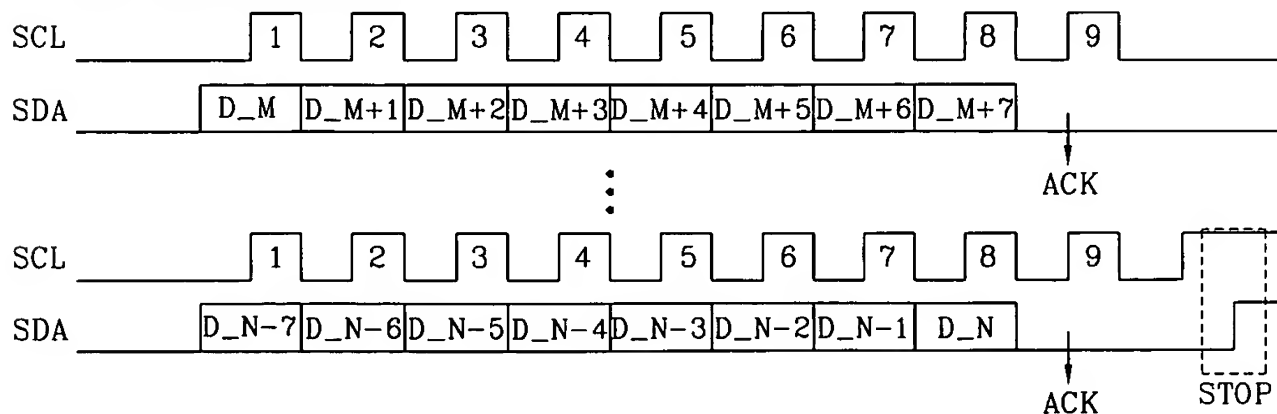
FIG. 8G

CASE 7. LINE DATA WRITE(TEXT)
SLAVE ADDRESS TRANSFER

SCL | 1 2 3 4 5 6 7 8 9

SDA

START MSB SLAVE ADDRESS LSB WRITE ACK

MODE SETTING

SCL | 1 2 3 4 5 6 7 8 9

SDA | 0 1 0 1 X

DISPLAY TYPE LINE DATA OSD EOFD ACK
TEXT MEMORY
SELECTION

LINE ADDRESS TRANSFER

SCL | 1 2 3 4 5 6 7 8 9

SDA | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 |

ACK

TEXT DATA TRANSFER

SCL | 1 2 3 4 5 6 7 8 9

SDA | D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 |

ACK

SCL | 1 2 3 4 5 6 7 8 9

SDA | D168 | D169 | D170 | D171 | D172 | D173 | D174 | D175 |

ACK STOP
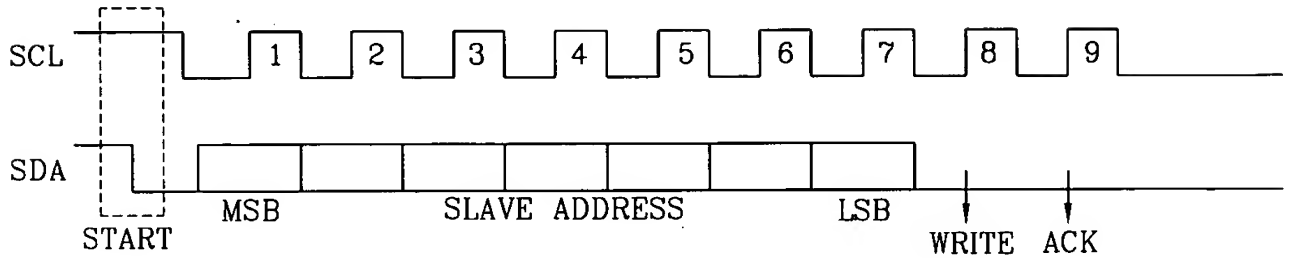
FIG. 8H

CASE 8. PIXEL DATA WRITE(TEXT)
SLAVE ADDRESS TRANSFER
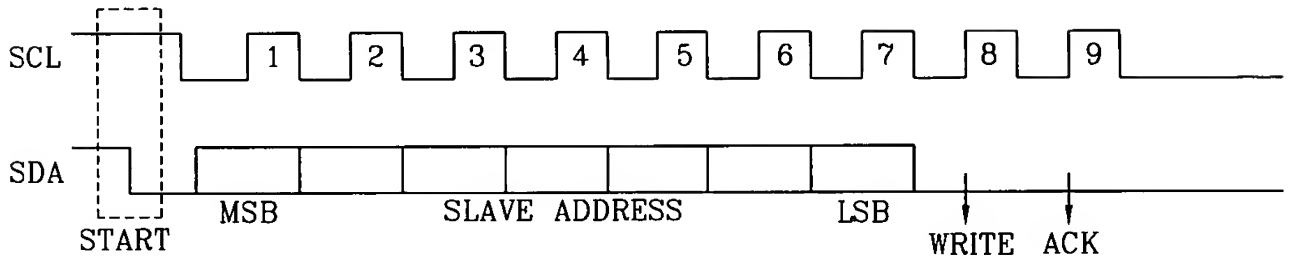
SCL   1 2 3 4 5 6 7 8 9

SDA

MSB   SLAVE ADDRESS   LSB

START   WRITE ACK

MODE SETTING

SCL   1 2 3 4 5 6 7 8 9

SDA   0 1 1   X

DISPLAY TYPE   PIXEL DATA   OSD   EOFD
          TEXT   MEMORY   ACK
                                SELECTION

PIXEL ADDRESS TRANSFER

SCL   1 2 3 4 5 6 7 8 9

SDA | A15 | A14 | A13 | A12 | A11 | A10 | A9 | A8 | ACK

SDA | A7 | A6 | A5 | A4 | A3 | A2 | A1 | A0 | ACK

ACK

TEXT DATA TRANSFER

SCL   1 2 3 4 5 6 7 8 9

SDA | D_N | D_N+1 | D_N+2 | D_N+3 | D_N+4 | D_N+5 | D_N+6 | D_N+7 |

ACK   STOP

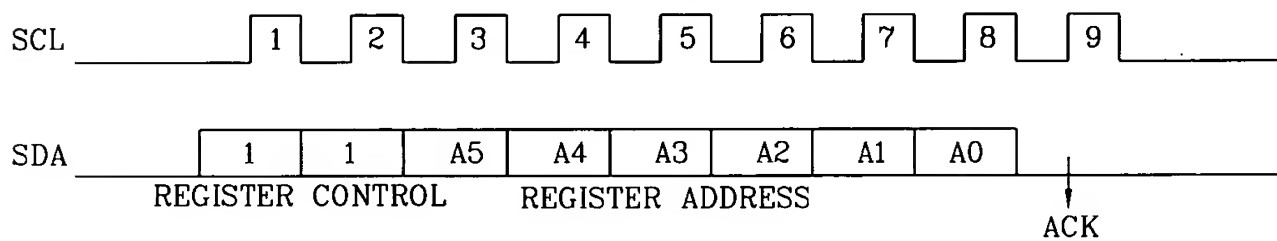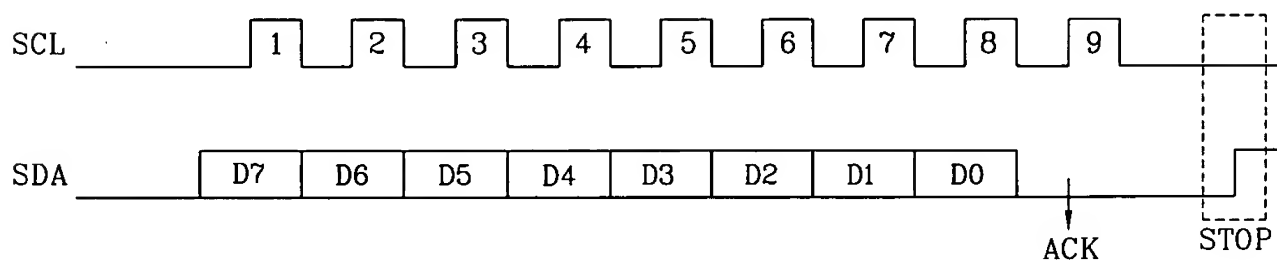# FIG. 9

SLAVE ADDRESS TRANSFER
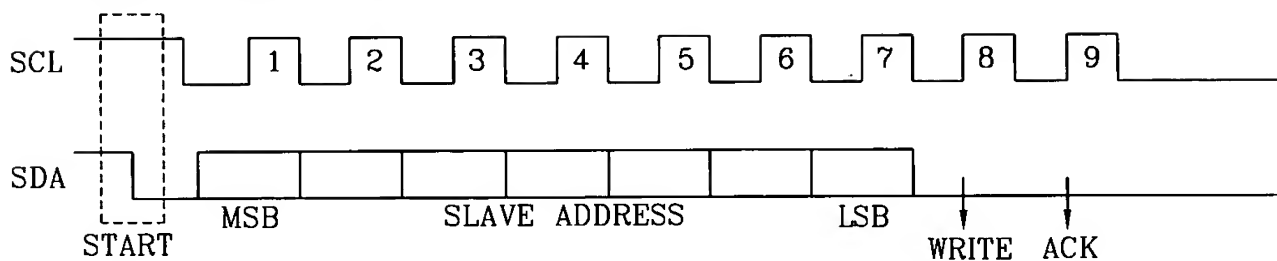
MODE SETTING & REGISTER ADDRESS TRANSFER

REGISTER DATA TRANSFER